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Three placodioid species of *Lecanoraceae* new for China

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Abstract — Three placodioid lichen species, *Lecanora valesiaca*, *Protoparmeliopsis sierrae*, and *Rhizoplaca phaedrophthalma*, are reported for the first time from China. Detailed taxonomic descriptions with high resolution photographs, chemistry, remarks, and distribution are provided.

Keywords —ascolichen, pruinose thallus, rosettes, squamulose-areolate, taxonomy

Introduction

Lecanoraceae Körb. (*Lecanorales*, *Lecanoromycetes*, *Ascomycota*) contains 26 genera with about 800 species worldwide (Lücking & al. 2017; Kraichak & al. 2018). Only 153 species representing nine genera have been reported from China thus far: *Carbonea* (Hertel) Hertel (3 spp.), *Clauzadeana* Cl. Roux (1 sp.), *Lecanora* Ach. (119 spp.), *Lecidella* Körb. (13 spp.), *Miriquidica* Hertel & Rambold (3 spp.), *Myriolecis* Clem. (3 spp.), *Rhizoplaca* Zopf (7 spp.), *Protoparmeliopsis* M. Choisy (2 spp.), and *Pyrrhospora* Körb. (2 spp.) (Wei 1991; Abbas & Wu 1998; Abbas & al. 2001; Aptroot & Sparrius 2003; Seaward & Aptroot 2005; Zheng & al. 2007; Zhang & al. 2012; Zhao & al. 2013, 2015; Lü & Zhao 2017). Among them, one *Lecanora* complex (*Lecanora muralis* group) and three genera (*Miriquidica*, *Protoparmeliopsis*, and *Rhizoplaca*) have placodioid or peltate-umbilicate thalli.

During our research on the placodioid taxa of *Lecanoraceae* in China, we identified three new records (*Lecanora valesiaca*, *Protoparmeliopsis sierrae*, *Rhizoplaca phaedrophthalma*), which we describe and illustrate below.

Materials & methods

The specimens were collected from Hebei, Inner Mongolia, Ningxia, Qinghai, Sichuan, and Xizang provinces in China and are deposited in the Lichen Section of the Botanical Herbarium, Shandong Normal University, Jinan, China (SDNU).

The macroscopic characters were examined under a COIC XTL 7045B2 stereomicroscope and photographed using an Olympus SZX16 dissecting microscope. Hand-cut sections were examined microscopically with an Olympus CX41 polarizing microscope and photographed with an Olympus DP72 camera attached to a BX61 microscope. Lichen substances were identified using standardized thin layer chromatography techniques (TLC) with solvent system C (Orange & al. 2010).

Taxonomy

Lecanora valesiaca (Müll. Arg.) Stizenb.,
Ber. Thätigk. St. Gallischen. Naturwiss. Ges.1880-81: 342 (1882) Fig. 1

Thallus placodioid, surface white to gray, areolate to rimose-areolate, usually forming distinct rosettes, heavily whitish pruinose, esorediate; margin distinct, with lobes, lobes 0.5–1.0 mm wide; prothallus not visible. Apothecia lecanorine, sessile, 0.3–1.1 mm in diam, crowded towards thallus center; disc yellowish brown to brown, epruinose, plane; margin concolorous with thallus, thin to thick, even to prominent, entire to flexuose, smooth, occasionally crenate. Amphithecium with small crystals insoluble in K; cortex distinct, basally not thickened, 17.5–25 μm thick; algal layer 50–75μm thick; parathecium hyaline, with crystals insoluble in K; epihymenium brown to blackish brown, pigment soluble in K, with fine crystals soluble in K, 7.5–15 μm thick; hymenium & subhymenium each hyaline, 25–50 μm thick; hypothecium indistinct; paraphyses simple, expanded apically, ≤3.5 μm wide; asci clavate, 8-spored; ascospores hyaline, simple, ellipsoid, 7.5–10(–12.5) × 4–7 μm. Pycnidia not observed.

Chemistry: Containing usnic acid.

Specimens examined: **CHINA. Hebei**, **Wenxian**, Mt. Xiaowutai, alt. 2100 m, 23/ /2012, H.Y. Wang 20121037. **Inner mongolia**, **Wulatehouqi**, Huhebashenge, alt. 1600 m, 16/VIII/2012, H.Y. Wang 20123653. **Ningxia**, **Mt. Helan**, Suyukou, Shibapan, alt. 2400m, 24/VIII/2007, F. Yang 20072669. **Qinghai**, **Menyuan**, Xianmilnchang, alt. 2750 m, 18/VIII/2007, Y.D. Du 20072131A-1; **Fengzhakou**, Haibeizhan, alt. 3200 m, 5/VIII/2007, Y.D. Du 20070594-2; **Qilian**, Binggoushangxigou, alt. 3320 m, 10/VIII/2007, X.L. Shi 20071381; alt. 3800 m, 20071432-2. **Sichuan**, **Litang**, alt. 4200 m, 5/XI/2008, Z.J. Ren 20080429.

Remarks: Compared with the published descriptions of *Lecanora valesiaca*, the Chinese specimens present shorter lichen lobes, a smaller apothecial disc, a

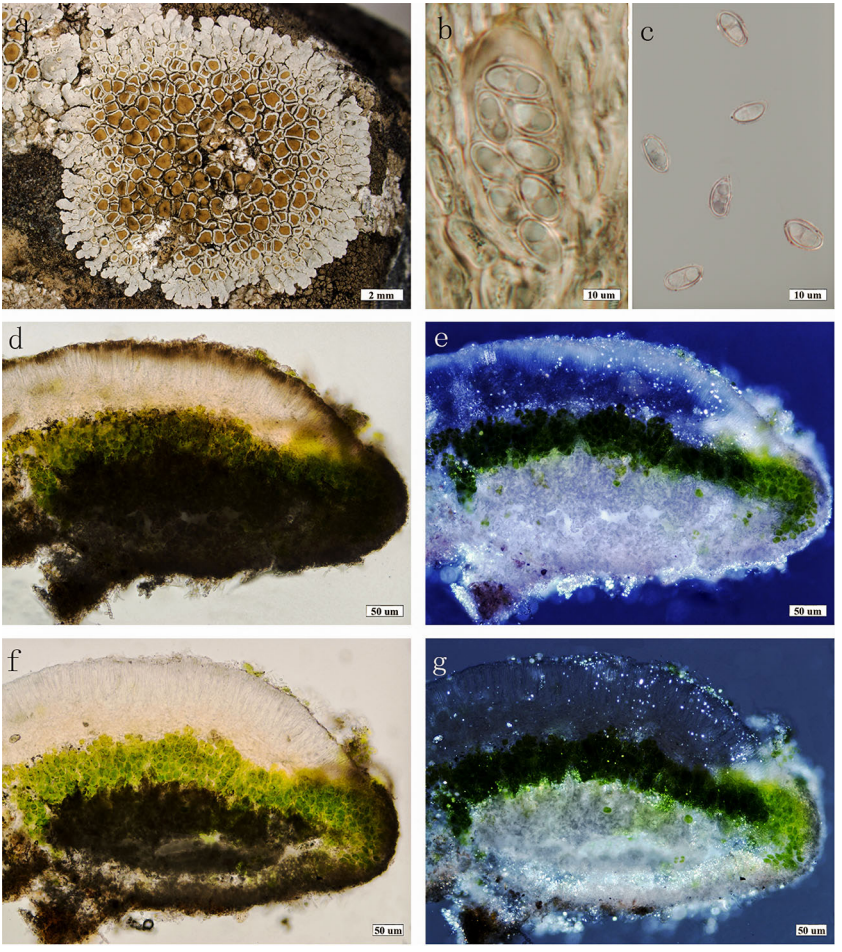

Fig. 1. *Lecanora valesiaca* (SDNU — Ren 20080429). a. Thallus; b. Ascus; c. Ascospores; d. Apothecium (section); e. Crystals in apothecial section; f. Epihymenial pigment, soluble in K; g. Epihymenial crystals, soluble, in K. a = 2 mm; b, c = 10 μm; d–g = 50 μm.

thinner epihymenium, hymenium, and subhymenium, and smaller ascospores. The fact that we did not observe pycnidia may be due to the relatively young age of our collections. *Lecanora valesiaca* is characterized by its closely adnate and completely whitish pruinose thallus and usnic acid as its sole lichen substance. It can be distinguished from other *Lecanora* placodioid species by its thin heavily pruinose thallus and absence of secondary metabolites.

Distribution: *Lecanora* Ach., with 552 species (Kirk & al. 2008), represents the largest genus in *Lecanoraceae*. Worldwide, *L. valesiaca* has been reported from Europe and North America (Ryan 1990). New to China.

Protoparmeliopsis sierrae (B.D. Ryan & T.H. Nash) S.Y. Kondr.,
Ukr. Bot. J. 69(6): 877 (2012) Fig. 2

Thallus placodioid; surface greenish gray to yellowish green, areolate, forming distinct rosettes, epruinose, esorediate; margin distinct, with lobes,

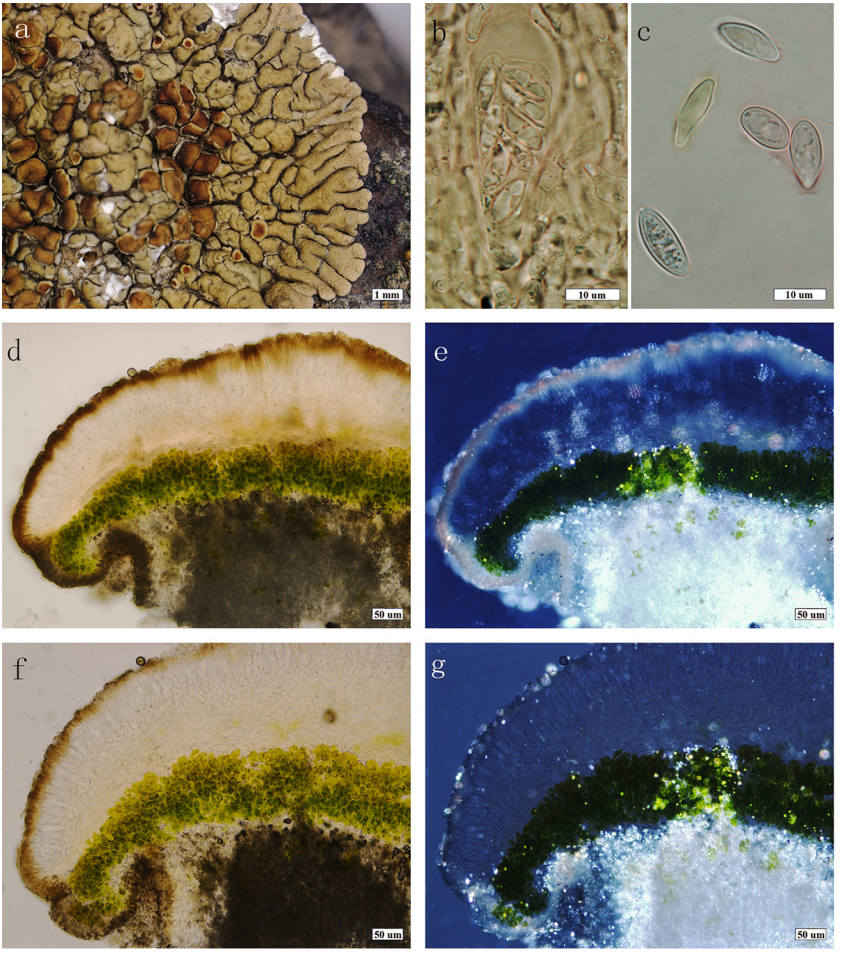

Fig. 2. *Protoparmeliopsis sierrae* (SDNU — Tong 20121126). a. Thallus; b. Ascus; c. Ascospores. d. Apothecium section; e. Crystals in apothecial section; f. Epihymenial pigment, partly soluble in K; g. Epihymenial crystals, soluble, in K. Scale bars: a = 1 mm; b, c = 10 μm; d–g = 50 μm.

lobes 1.5–4.0 mm long, 0.6–1.5 mm wide, rimose-areolate in the center, plane to swollen toward to tips, with surface roughened increasingly toward to tips and occasionally with pruina; PROTHALLUS not visible. APOTHECIA lecanorine, sessile, 0.4–1.3 mm in diam; DISC yellowish brown to reddish brown, epruinose, plane to convex; margin concolorous with thallus, thin, then excluded, even, entire, smooth. AMPHITHECIUM with small crystals soluble in K; cortex distinct, basally not thickened, with small crystals soluble in K, 17.5–30 µm thick; algal layer continuous below the hypothecium, 75–100 µm thick; PARATHECIUM hyaline, with crystals insoluble in K; EPIHYMENIUM reddish brown to dark brown, pigment partly soluble in K, with fine crystals soluble in K, 12.5–20 µm thick; HYMENIUM hyaline, 37.5–50 µm thick; SUBHYMENIUM hyaline, 50–100 µm thick; HYPOTHECIUM hyaline to pale brown, pigment soluble in K, 10–25 µm thick; PARAPHYSES simple, expanded apically, ≤3.5µm wide; ASCI clavate, 8-spored; ASCOSPORES hyaline, simple, ellipsoid, 7.5–15 × 5–7.5 µm. PYCNIDIA immersed, ostioles; CONIDIA filiform, 18–25 µm long.

CHEMISTRY: Containing pannarin and usnic acid.

SPECIMENS EXAMINED: **CHINA. HEBEI**, **Wenxian**, Mt. Xiaowutai, alt. 2100 m, 28/VIII/2012, D.B. Tong 20121126; alt. 2300 m, 28/VIII/2012, H.Y. Wang 20121538, 20121351. **INNER MONGOLIA**, **Duolun**, Shisanlitan, alt. 1434 m, 8/VIII/2010, Q. Ren 20101930. **QINGHAI**, **Mt. Qilian**, Binggouxiaxigou, alt. 3360 m, 10/VIII/2007, Y.D. Du 20071408. **XIZANG**, **Dangxiong**, Namucuo, alt. 4600 m, 28/VII/2011, Y.L. Cheng 20119125.

REMARKS: The Chinese collections differ from published descriptions of *Protoparmeliopsis sierrae* primarily in the presence of pannarin and usnic acid (and no isousnic acid) as main secondary metabolites. The species is characterized by its brightly coloured placodioid thallus and the presence of pannarin. Its more convex plicate lobes and possession of pannarin instead of zeorin separate *P. sierrae* from *P. muralis*.

DISTRIBUTION: *Protoparmeliopsis sierrae* has been reported from western North America (Ryan & al. 2004). New to China.

Rhizoplaca phaedrophthalma (Poelt) S.D. Leav., Zhao Xin & Lumbsch, Fungal Diversity 78: 302 (2015) FIG. 3

THALLUS placodioid; surface dark yellow to grayish yellow, usually with brownish tint, dispersed, bullate-areolate to squamulose-areolate, areoles occasionally rugose, ≤1 mm wide, esorediate; PROTHALLUS not visible. APOTHECIA lecanorine, sessile, 0.5–1.7 mm in diam; DISC yellowish brown, epruinose, plane to convex; margin concolorous with thallus, thick to excluded

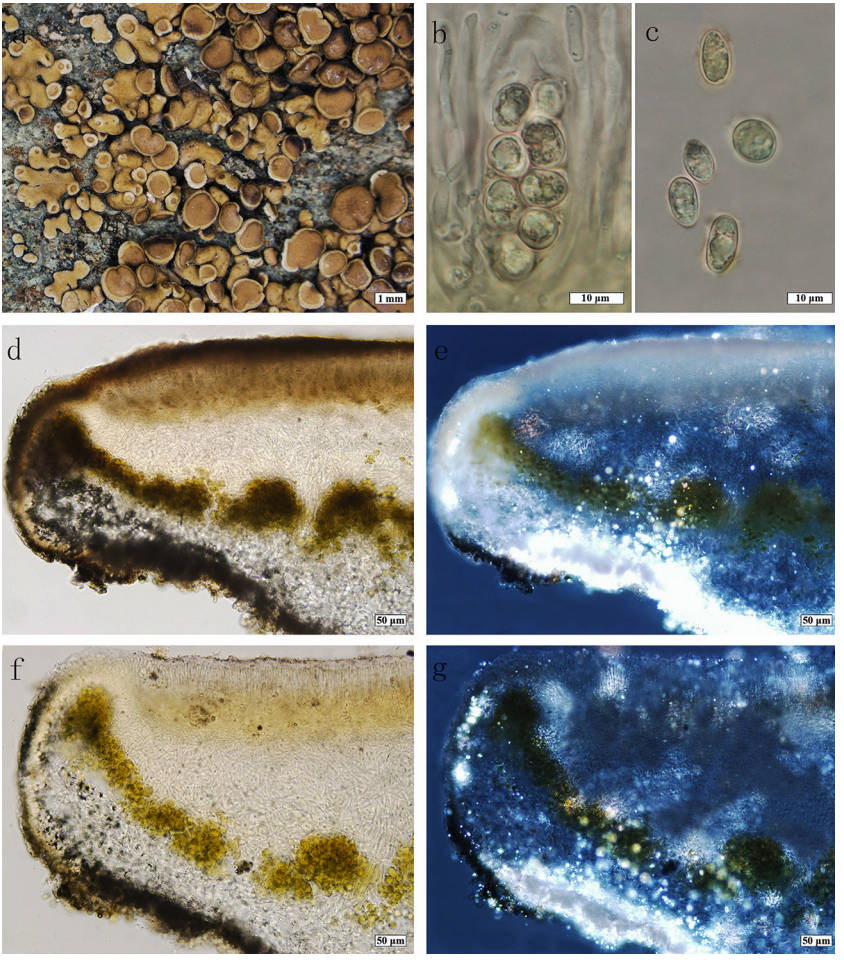

Fig. 3. *Rhizoplaca phaedrophthalma* (SDNU — Du 20070526). a. Thallus; b. Ascus; c. Ascospores; d. Apothecium section; e. Crystals in apothecial section; f. Epihymenial pigment, partly soluble in K; g. Epihymenial crystals, soluble in K. Scale bars: a = 1 mm; b, c = 10 μm; d–g = 50 μm.

(when mature), even, entire, occasionally flexuose, smooth. Amphithecium with small crystals soluble in K; cortex distinct, basally not thickened, 25–30 μm thick; algal layer 50–62.5 μm thick, with medulla between cortex and algal layer, 50–130 μm thick; parathecium hyaline; epihymenium reddish brown to dark brown, pigment soluble in K, with fine crystals soluble in K, 10–15 μm thick; hymenium hyaline, 50–67.5 μm thick; subhymenium

hyaline to pale yellow, 40–65 µm thick; HYPOTHECIUM hyaline, 67.5–83.5 µm thick; PARAPHYSES simple, expanded apically, ≤3.5 µm in diam.; ASCI clavate, 8-spored; ASCOSPORES hyaline, simple, ellipsoid, often not well-developed, 7–10 × 4.5–7 µm. PYCNIDIA not observed.

CHEMISTRY: Containing usnic acid, placodiolic acid, and zeorin.

SPECIMENS EXAMINED: **CHINA. QINGHAI, Menyuan**, Fengzhakou, alt. 3200 m, 5/VIII/2007, Y.D. Du 20070526; 3/VIII/2007, X.L. Shi 20070220; Lenglongling, alt. 3520 m, 7/VIII/2007, Z.S. Sun 20070850-1; 7/VIII/2007, X.L. Shi 20070860; alt. 3630 m, 7/VIII/2007, Y.D. Du 20070961.

REMARKS: The Chinese specimens have a thicker hypothecium than published descriptions and contain zeorin in addition to usnic acid and placodiolic acid. *Rhizoplaca phaedrophthalma* is characterized by a bullate-areolate to squamulose-areolate thallus, occasionally rugose areoles, thick medulla in the amphithecium between cortex and algal layer, and the presence of placodiolic acid. Originally described as *Lecanora phaedrophthalma* Pole, the species was transferred to *Rhizoplaca* based on molecular analysis (Zhao & al. 2016).

DISTRIBUTION: *Rhizoplaca phaedrophthalma* has been reported from central Asia and North America (Ryan & al. 2004). New to China.

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